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AUTHOR Gandy, Oscar H., Jr.
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ABSTRACT

Because broadcasting is an industry that produces goods and services for sale, any government action which would limit its technical and economic efficiency represents a serious threat. Program violence raises much criticism; at the same time, the industry recognizes its audience-producing value. An audience production function estimate was derived from a study of seven weeks of television programs recorded between 1971 and 1976. The study measured televised violence according to seriousness, significance, rate, and the number of violent acts. In addition, estimates of audience size for each program were recorded. Industry and network level analyses of the data revealed that while the average viewers do prefer more rather than less violence, audience size depends on which network airs the program and on what is available during the viewing time. These findings point the way toward improvement of regulatory efforts on the part of goverment agencies that seek to regulate program content. (HAI)

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AUDIENCE PRODUCTION FUNCTIONS: A NEW LOOK AT THE ECONOMICS OF BROADCASTING

Oscar H. Gandy, Jr., Ph.D.

Howard University
School of Communications
Department of Radio, Television and Film
Washington, D. C.

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INTRODUCTION

Recent interest by citizen groups, government agencies and committees of the Congress[1] in the content of television programs has generated great concern within the broadcast industry. While the industry response is typically couched in the form of pleas for the preservation of First Amendment freedoms, the concerns of broadcasters are quite properly centered on the potential economic consequences of any sustained interference with a proven technology.

Broadcasting in the US is an industry like others which produces goods and services for sale in the marketplace. Like other producers, the broadcaster must be concerned with the technical and economic efficiency of the methods used to produce its product, and any government action which would restrict or restrain the use of that technology represents a serious threat. Since program content is the principal ingredient in the production of audiences for sale to advertisers, any restriction on content might affect the profitability of firms within the industry.

Violence is one aspect of television content which has been singled out for special attention in recent years. Like industrial chemicals which are believed to cause harm to the environment when they are used in the production of some valued product, excessive violence is seen to be polluting the social environment, and the general sentiment is that its use must be restricted.

Currently, there is no reliable method for estimating the gains or losses in productivity that would accompany such an important change as the elimination of violence from television. This paper will discuss the potential of a production function approach as a method for estimating the impact of changes in the technology of audience production.

BACKGROUND

The relationship between programming and broadcast profitability has long been a subject of regulatory interest. Broadcasters have argued that CATV systems would contribute to the demise of local broadcasting because the introduction of additional signals would "fractionalize" the audience, reducing the revenue of the local stations. The arguments of the broadcasters were supported in appearances before the Federal Communications Commission (FCC) by theoretical economic models which sought to demonstrate the impact of one or more additional channels in a market.[2]

On the other side of the economic issue, supporters of CATV development appealed to the FCC's expressed goal of increasing program diversity, by arguing that by offering additional television signals, CATV would increase the diversity available to the viewer.

Arguments about the impact of CATV on either broadcast revenue or consumer satisfaction have not been conclusive because of a failure on the part of the economists to come to terms with the measurement of diversity. Study after study sought to describe diversity in terms of variations in the mix of a limited of program types. Programs were either classed broadly as Movies, Sports, Entertainment or Educational, or within the Entertainment category, into Adventure, Comedy, Variety, Westerns, Drama, etc. None of these classifications truly captured the variety in programming which actually guides the viewer in selecting one program or another.[3]

More restricted program choice models such as those of J. Rothenberg, P. Steiner and J. McGowan[4] are based on ideal types of programs which are supposed to cover the spectrum of choices available to television viewers.

Because of these arbitrary limitations on the diversity of choices actually facing the average viewer in these studies, B. Owen, J. Beebe and W. Manning (1974) concluded that:

> "That total audience for network television at a given moment is evidently not much affected by program content or type within the range of variation with which we have experience (p.95)."

Suggesting further that the network audiences are determined almost entirely by exogenous seasonal factors.

Edward Greenberg and Harold Bennett (1971) demonstrated that there were many program characteristics other than type which were important to viewers. By studying the audience shares for a large sample of televised films, they demonstrated first that Film could not be a single category if there was such great variance in the audience shares reported for these films. Further, they demonstrated that variables such as familiarity with the film were more important predictors of audience size than the categories of film type used by the industry. F. Zufryden (1976) identified several exogenous factors which might govern television program selection, but he failed to consider either the characteristics of the stations of the characteristics of the programs themselves.[5]

Efforts to determine consumer preferences in terms of the attributes of the products, rather than the product itself, have become familiar in the marketing literature following the publication of important works by Kelvin Lancaster (1966, 1977). Lancaster's work argued that an orange is eaten, not because it is an orange, but because of its taste, texture, and nutritional value. He sought to describe the consumption technology in terms of the bundles of characteristics which could be provided by one or more product varieties.

Extensions of the Lancasterian model include multi-attribute preference models[6] and an attempt by Donald Lehmann (1971) to determine preferences for television programs in terms of attributes like Action, Suspense, Humor and other qualities like being well-produced and directed.

Byron Reeves and Bradley Greenberg (1977) sought to determine the content attributes used by young children in the selection of television programs, and the identification with certain characters in those programs. Reeves and Greenberg selected eight attributes for television characters, including funny, active and strong, and determined that only four dimensions were necessary to account for the variance in the preference of tv characters.

This multi-attribute approach represents a considerable advance over the gross categories used in earlier studies, but the absence of reliable data sources which describe programs in terms of such attributes has greatly reduced the amount of empirical research into the relations between television program attributes and viewer preference and choice.

PRODUCTION FUNCTIONS

G. David Hughes (1973) suggests that attribute models of consumer demand are the inverse of industrial production models. That is, the producer combines inputs in a certain ratio, which is fixed by the state of technology, and it yields a certain output of goods, the attributes of which are preferred by an aggregation of consumers.

If we consider that television uses program attributes as inputs in a certain ratio to produce a package attractive to an audience, the inverse of model has the audience members selecting certain combinations of program attributes in order to produce satisfaction from television watching. Thus the broadcaster's selection of programs of a certain type, with a certain combination of attributes, is the use of a production technology which can be described in functional form.

The use of production functions is well developed in the field of microeconomics. The production function is defined as the

> "relationship between the quantities of various inputs used per period to time and the maximum quantity of the commodity that can be produced per period to time...the maximum output rate that can be achieved from any specified set of usage rates of inputs."[7]

With the production function, one is able to determine the marginal product of each input factor. These functions are estimated through statistical analysis of time series data concerning the amounts of particular inputs used at various times in the past, and the amount of output produced at the same time.

The use of the production function has been extended to analyses in other fields where one is concerned with the technical and economic efficiency of a production process. In studies of educational effectiveness, the "educational production function" is used to represent the relationship between school resources and the background of the students on one hand, and a variety of educational outcomes, like test scores on the other.[8] Least squares multiple regression is used to estimate coefficients for these inputs, and researchers have estimated the marginal product, or relative importance of teacher salary, books and school supplies, teacher verbal ability, percentage of white students, and other factors believed to affect some educational output.[9]

In the television case, when attempts to determine the program preferences of the audience are based on the attributes of the programs, we are in fact describing the technology of the broadcaster who is seeking to maximize the size of the audience. If sufficient data were available on a range of program attributes, and on the size of the audience those programs produced, it would be possible to estimate an audience production function, and the marginal product of each of the program attributes.

Since program violence has been criticised at the same time that the industry notes its value as a producer of audiences,[10,11] any attempt to estimate an audience production function should include violence, "action," or its equivalent.

A preliminary study of the productivity of television violence was begun by the author as a Post-Doctoral Fellow at the Annenberg School of Communications at the University of Pennsylvania. The study was initiated originally as an at-

tempt to evaluate the proposition that "there is violence on television because that is what the public wants." Discussion with George Gerbner, Klaus Krippendorff, R. L. Shayon and others on the faculty suggested an alternative formulation of the problem: "there is violence on television because the networks have determined that it is an efficient technique for the production of audiences." As we have discussed above, one is the inverse of the other, and both can be evaluated with the same data.

METHODS OF THE STUDY

The Cultural Indicators Project at the University of Pennsylvania has been studying trends in television program content since 1967.[12] A staff of trained coders, working in pairs to improve reliability, describe each program along several content dimensions. Prior to 1975, samples were limited to a calendar week in each year. An analysis of the single week sample, when compared with a 365-day sample from the same year (1967-68), revealed no significant differences in the distribution of program types, or in measures of program tone. However, following 1975, the sampling period was increased to two weeks, one in the fall, and the other in the Spring.

For the purposes of this project, seven sample weeks, recorded between 1971 and 1976 were selected for analysis. Program descriptions, as produced by the Cultural Indicators Project were used as attributes, or production factors in the estimation of audience production functions.

Most variables are in ordinal or interval form, with the exception of a single dummy variable, Old, which distinguishes between new programs, or returning series.

Three original and one computed measure of the amount and kind of violence were selected for each program in the sample:

1. Seriousness of Violence = an ordered list ranging from no violence, through through real, serious violence (as to distinguish between this and comedic, humorous violence).

2. Significance of Violence = an ordered list ranging from no violence, through violence which is seen as being the major outstanding feature of the climax.

3. Number of Violent Acts = a simple count of the number of violent actions occuring within a program, where violence is defined as "the overt expression of physical force against self or other, or compelling action against one's will on pain of being hurt or killed, or actually hurting or killing."

4. Violence Rate = calculated by dividing the number of violenct acts by the number of program minutes to get an estimate of violent acts per minute.

OUTPUT MEASURES

Several estimates of audience size were recorded for each program as reported by the A. C. Nielsen Company in their National Television Index.

1. Audience 1 = the percent of television households watching the program during the average minute, of the first quarter hour of each half hour the program is aired.

2. Audience 2 = the percent of television households watching the program during the average minute of the second quarter hour.

3. Share = the percentage of households viewing television who are tuned to a given program, estimated every half hour.

4. Loss = the change in the percent of television households viewing a particular program between the first and second half of each 30-minute segment (Loss=Audience 1-Audience 2).

FINDINGS

Analysis of the data necessarily takes place at two data levels. Treating television as an industry with a common production technology, it is possible to estimate the relative importance of program attributes like violence to audience production in general. One can examine the simple correlation between separate estimates of violent content and estimates of audience size. Industry-wide

production functions can be estimated which reflect the independent contribution of several content variables to overall industry output when all other factors are held constant. Most studies of the relationships between content, or program type and audience or viewer preference are focused at this general level.

However, it has been noted that treating the industry as a whole fails to consider two important factors of the audience production process. First, production takes place within a set period of time, and the audience or product is not consumed, but may be produced again in the next time period. During that time period, a quarter hour in this analysis, there is more than one producer seeking to use the resources out of which audiences are made. Thus, the industry wide model does not adequately reflect the competition for resources which describes audience production. By examining the simple correlation between attribute and audience, the industry wide analysis does not account for the significant differences between quarter hour periods, in terms of the amount of choice the television household is presented with.

Secondly, the industry-wide approach fails to consider the liklihood that each network, or producer may either use a slightly different production technology, or may be somewhat more efficient in the use of the same technology. Both of these considerations are taken into account in the second level of analysis.

INDUSTRY LEVEL ANALYSIS

In examining the correlations between program attributes and a variety of output measures, we are not surprised to find that old, returning programs are successful in producing large audiences (Table One). However, we are surprised to discover that the amount of violence is relatively unimportant to audience size, while the seriousness and significance of that violence is inversely related to audience size. That is to say, that when the violence is serious, rather than

humorous, sham violence, there are generally smaller audiences. Similarly, when the violence is the major outstanding feature of the climax, as opposed to being incidental to the plot, the audience tends to be smaller.

Since there are important interactions between these variables, including them in a multiple regression equation makes it possible to examine their importance with all other factors held constant. Here we find that the amount of violence emerges as a signicant factor in all three equations (Table Two). In each equation, the sign of the coefficient should be interpreted to mean that increases in the amount of violence are associated with increases in the size of the audience for each program. The negative sign in the third equation reflects the fact that there was a negative loss, or a gain in audience between first and second quarters when there was more violence in the program.

The seriousness of the violence is not significant in any of the equations, suggesting that much of the variance in seriousness is captured when the amount of violence is held constant. The role of the significance of violence to the plot or climax also is diminished in these equations, however, it is still an important, negative factor in the audience production process. The significant negative coefficients for Year may be a reflection of the increased competition from non-network program sources in recent years.

While the first two equations are both significant at the .(level, the amount of explained variance is quite small, suggesting that industry-wide models are inadequately specified.

NETWORK LEVEL ANALYSIS

With each network treated as an individual firm, and with the relevant production period identified as the half hour, we are able to specify the production functions more completely, as is reflected in the greatly enlarged coefficients of determination (R-squared).

In this form, we are able to see that the output of ABC is determined not only by the attributes of ABC programs during any half hour, but by the attributes of simultaneous offerings by NBC and CBS (Table Three). Though only the third equation is significant at the .01 level, each has several significant variables. We see that the amount of violence in competing CBS programs has a significant and negative influence on the size of the ABC audience.

In fact, CBS program attributes were generally the most important determinants of ABC audience shares (ABC_2), though in the second quarter measures (ABC_1), it is apparent that ABC programas were more successful against NBC continuing programs.

The amount of violence in ABC programs was of little importance in any estimate of productivity, and the seriousness of that violence actually contributed to a loss of audience between clock half hours (ABC_3).

None of the equations for NBC were significant, though as for ABC, several variables are significant at the .01 level. Not a single attribute of NBC's own programming apparently made any important contribution to variance in audience size (Table Four). However measured, returning series on CBS always meant smaller audiences for NBC, as reflected in high negative coefficients for CBS/Old in NBC_1 and NBC_2. The high positive coefficient (.355) in NBC_3 should be interpreted to mean that when a returning series was scheduled next on CBS, more of NBC's audience changed channels to watch that series.

Part of the success of CBS programs in competition with NBC, was apparently the attractiveness of their violence. A lot of violence, incidental to the plot on CBS programs apparently cost both NBC and ABC their audiences. Though ABC was not able to draw audiences away from CBS with liberal doses of violence, it is apparent that this approach did improve their competitive stance against NBC. The amount of violence in ABC programs was a significant negative influence in both

in both NBC_1 and NBC_2.

The most successful models were estimated for CBS. This is understandable in part because of the long history of ratings leadership which CBS enjoyed until it was unseated by ABC. Thus, it is reasonable to assume that the CBS technology had been tested and refined, while the other two firms were trying different program mixes in search of an optimum formulation. There is support for this finding in Joseph Dominick and Millard Pearce's (1976) study of trends in network prime-time programming. They note that "all three networks seldom undertake major content shifts in the same year; two usually change, while the third remains stable (p.79)."

We are able to explain more than 70 percent of the variance in the percent of households viewing CBS programs during the seven sample weeks, 60 percent of the variance in audience share, and nearly 60 percent of the changes between previous and first quarter audiences (Table Five).

The CBS package contained a liberal amount of violence as reported by Gerbner et al [13]., and apparently paid off in terms of ratings and audience shares. Both coefficients for the amount of violence in CBS programs were positive and significant at the .01 level (CBS_1, CBS_2). To a greater extent than with the other networks, the less significant the violence was to the plot or to the climax of the program, the more it contributed to audience size.

The only serious competition CBS was faced with during these years was apparently from established NBC programs, since the appearance of a continuing NBC serial during the same half hour meant a significant loss in both ratings and shares for CBS, if all other factors were equal.

DISCUSSION

Production functions at both the industry and network level provide support for the frequently expressed belief that violence is an important factor in the production of television audiences. For CBS, the industry leader during the bulk of the sample period, the amount of violence in its program schedule emerged as one of the most important contributions to audience size. The data suggest that

not just any violence will serve the broadcaster's purpose, since in the experience of CBS, it was the gratuitous, less serious violence that contributed most to audience size.

However, while the industry model may be interpreted to mean that the average viewer prefers more rather than less violence, the network-specific models suggest that it depends upon which network has the program, and what else is available during the viewing period. This suggests, of course, that there are other, perhaps more important variables not included in this model which would explain why violence works for CBS and not for the other networks.

In addition, several factors would argue for caution in interpreting the network models. Because of the statistical requirements for comparability in multiple regression, missing data for any variable for any network would result in the elimination of the entire half hour period. Thus, the network equations were estimated on the basis of a relatively small number of program periods (n=54). And since the Cultural Indicators Project did not generate data for variety, sports, or information specials, only 18 percent of the half hour periods in the seven sample weeks could be included in the analysis of networks, while some 459 cases were included in the industry analysis.

Finally, after 1976, there have been significant changes in television programming and by inference, audience tastes. With ABC in place as the new ratings leader, we would expect changes in the coefficients for the variables in their model. Indeed, the coefficients for all the models would differ if a seven week sample were analysed for the 1977-78 season. As Ray Hill (1977) suggests, audience tastes are no longer predictable, since program changes have become the rule, whereas in the past familiar characters and situations represented the route to success:

> "A few years ago networks could point to stable audiences. The shows appeared each week. They appeared in the same time slots. The viewers knew when and where to find them. Now everything is a jig-saw puzzle...It used to be that there was a new season and a second season...Now each week is a new season (p.33)."

However, when the industry settles again into a stable pattern, as it must if it is going to retain the devotion of the advertising community, the production function approach can describe that new technology. In addition, if production cost and advertising revenue data are introduced into the model, it would be possible to estimate the marginal product of various program attributes in dollar terms. That is, multiple regression would allow the estimation of the marginal cost of attributes such as violence, humor and sexual innuendo, so that they could be compared with the marginal revenue associated with the sale of audiences with particular demographic characteristics.

CONCLUSION

Clearly this effort represents just a start. Data has been limited to a single class of program attributes, measured on a small and possible biased sample. Yet, I believe that the method points the way toward improvement of regulatory efforts on the part of the FCC, FTC. FDA, or any other agency that would seek to regulate program content. With approach, empirical evidence could be brought to bear on regulatory decision making in the area of CATV, subscription television, and other telecommunications systems which are seen to threaten the economic viability of broadcasting as we know it today.

Notes:

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TABLE ONE

Input-Output Correlations at the Industry Level						
Output Measures	Input Factors					
	Serious	Significant	Amount	Year	Old	Time
Audience I	-.071 *	-.051	-.034	-.007	.071 *	-.026
Audience II	-.093 *	-.079 *	-.023	.022	.095 **	-.047
Share	-.109 **	-.114 **	.007	.016	.331 **	-.070 *
Loss	.010	.030	-.035	-.060	-.018	.023

* p= less than .05
** p= less than .01

TABLE TWO

Industry-Wide Production Functions (N=459)

FACTORS	1_1	1_2	1_3
Old	.203**	.343*	-.005
Year	-.100**	-.100**	-.061
Amount	.163**	.124**	-.096*
Significant	-.083	-.147*	.140*
Serious	-.031	.017	-.051
Time	-.021	-.052	.012
R-squared	.064	.139	.013
F	5.223**	12.228**	1.054

1_1 = Percent of television households watching a given program in the second quarter-hour

1_2 = Percent of viewing households watching a given program during each half-hour

1_3 = Loss of viewers between first and second quarter hours

* = p less than .05
** = p less than .01

TABLE THREE

ABC Audience Production Functions (N=84)

FACTORS	ABC_1	ABC_2	ABC_3
ABC/Serious	-.075	-.092	.302**
ABC/Significant	.120	.194	.101
ABC/Amount	-.213	-.227	-.189
CBS/Serious	.134	.116	.214
CBS/Significant	.167	.376**	.048
CBS/Amount	-.300*	-.339**	.127
NBC/Serious	-.020	-.007	-.036
NBC/Significant	.102	.143	.133
NBC/Amount	-.351**	.098	-.126
ABC/Old	.120	-.047	-.400**
CBS/Old	-.224	-.375**	.122
NBC/Old	.420**	.530**	.042
Year	.050	.212	.379**
Time	-.064	-.056	-.059
R-Squared	.305	.386	-.448
F	1.226	1.941	2.262*

* p= less than .05

** p= less than .01

ABC_1 = Percent of television households watching ABC in the second quarter hour.

ABC_2 = Percent of viewing households watching ABC during each half hour.

ABC_3 = Change between previous and first quarter hour audience

TABLE FOUR

NBC Audience Production Functions (N=S4)

FACTORS	NBC 1	NBC 2	NBC 3
ABC/Serious	-.205	-.112	.032
ABC/Significant	.011	.096	.028
ABC/Amount	-.276*	-.317**	-.086
CBS/Serious	.177	-.006	.199
CBS/Significant	.258	.541***	.221
CBS/Amount	-.387**	-.318*	-.058
NBC/Serious	-.175	-.128	.015
NBC/Significant	-.129	-.081	-.039
NBC/Amount	.170	.213	-.109
ABC/Old	.088	-.192	-.256
CBS/Old	-.355*	-.399**	.355**
NBC/Old	.063	.236	-.125
Year	-.222	-.042	.223
Time	.118	.162	.003
R-Squared	.221	.245	.383
F	.877	1.000	1.914

* p = less than .05

** p = less than .01

NBC_1 = Percent of television households watching NBC in the second quarter hour.

NBC_2 = Percent of viewing households watching NBC during each half hour.

NBC_3 = Change between previous and first quarter hour audience for NBC.

TABLE FIVE

CBS Audience Production Functions (N=S4)

FACTORS	CBS 1	CBS 2	CBS 3
ABC/Serious	.043	.154	.529**
ABC/Significant	-.189	-.144	-.039
ABC/Amount	.259**	.247**	.059
CBS/Serious	-.044	-.198	.235*
CBS/Significant	-.747**	-.585**	.116
CBS/Amount	.382**	.517**	-.058
NBC/Serious	-.096	-.000	.129
NBC/Significant	.024	.053	.132
NBC/Amount	.126	.098	-.106
ABC/Old	.382**	.104	-.156
CBS/Old	.650**	.709**	.140
NBC/Old	-.573	-.446**	-.066
Year	-.341**	-.197	.375**
Time	.057	.028	.061
R-Squared	.708	.604	.593
F	6.782**	4.705**	4.065**

* p = less than .05

** p = less than .01

CBS_1 - Percent of television households watching CBS in the second quarter hour

CBS_2 = Percent of viewing households watching CBS during each half hour.

CBS_3 = Change between previous and first quarter audience for CBS